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Privacy Preserving Biometric Verification

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Abstract—Template and databases are very important part of biometric system and attacker mostly attacks on template and database of biometic system, so securing them is very important. Size of the database is very large so reduce database size is also very crucial issue these days . Our aim is to provide privacy to the user by protecting template and to reduce dimension of the template database for effective computations.With this aim in mind we have proposed Classical Multidimensional scaling technique which is very effective in dimension reduction as well as it also provides privacy to the user by securing template . We have implemented biometric system using PCA, RP, PCARP and Classical MDS.Experimental results show that proposed technique is more effective in dimesion reduction as well as it also improves the recognition rate of the biometric system.Comparative analysis of Proposed method with PCA ,RP,and PCARP are also discussed.

Index Terms— **Biometric System, Template, PCA, Random Projection, Classical Multidimensional scaling, Face recognition, Privacy, dimension reduction etc.**

Introduction

Traditional authentication system based on something you know e.g.Password and something you have e.g.Token. But these methods provide low level of security [1]. Since passwords and PINs can be forgotten or acquired by covert observation, while tokens and ID cards can be lost, stolen, or easily forged,hence Instead of utilizing something a person remembers or possesses, biometrics determines an individual's identity based on something he/she naturally possesses, either physiologically or behaviorally.Biometric authentication overcome the problem of conventional authentication methods. In Biometric system there are two phases Training Phase and Testing Phase There are several advantages of Biometric sytem against tradional authentication system. Due to this it is widely used for user authentication in various applications.Hence attackers are now focus on this sytem. Template and databases are very important part of biometric system and attacker mostly attacks on template and database of biometic system [4]. So securing them is very important and size of the database is also very large so reduceing database size is crucial issue these days.

2 EXISISTING SYSTEMS

Most common technique is Principal Component Analysis[11] which is useful in dimension reduction but it is computatioanly expensive. Recently Random projection [2] is used to generate template. It is more effective in dimension reduction as well as it provides more privacy to the user.

In biometric system there are two phases i.e. Training phase and Testing Phase. The Testing phase is responsible for enrolling individual's biometric data into the biometric system database. In the Training phase, the biometric characteristic of an individual is first scanned by a biometric reader to produce a

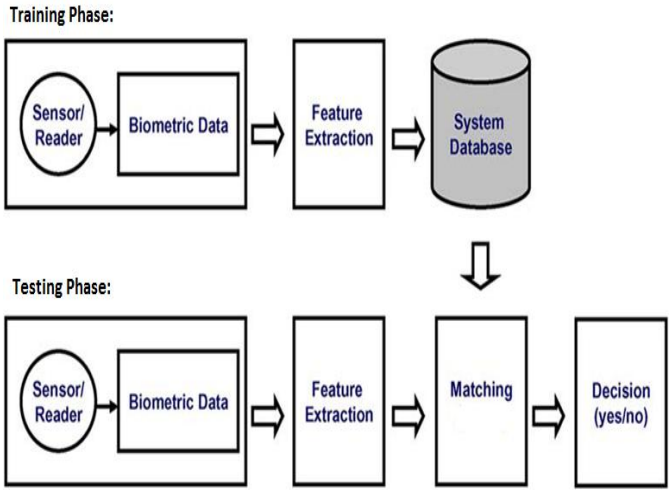

Fig1. General Architecture of Biometric System [2]

digital representation of the characteristic. The data capture during this process may or may not be supervised by a human depending on the application.

This input digital representation is further processed by feature extractor module in order to facilitate matching and generate a compact but expressive representation, called a template. Depending on the application, the template may be stored in the central database of the biometric system or to be recorded on a smart card issued to an individual. These templates are used further for the authentication of an individual

In the Testing phase the new biometric template is created and it is compared against the stored template.

A biometric system has following four main modules

1 Sensor module:
It captures the biometric data of an individual
2 Feature extraction module
In which the acquired biometric data is processed to extract the salient or discriminatory features.
3 Matcher module
During authentication, features are compared against the stored features to generate matching scores
4 Template database module

To store the biometric features or templates of enrolled Users.

We have proposed Classical Multidimensional Scaling Algorithm which is more effective than other techniques in dimension reduction as well as it provides more protection to the template

3 PROPOSED SYSTEM

The multidimensional scaling (MDS) [6] refers to a family of techniques for dimensionality reduction that are used to represent high-dimensional data in low-dimensional space while approximately preserving distances.

Training Phase:

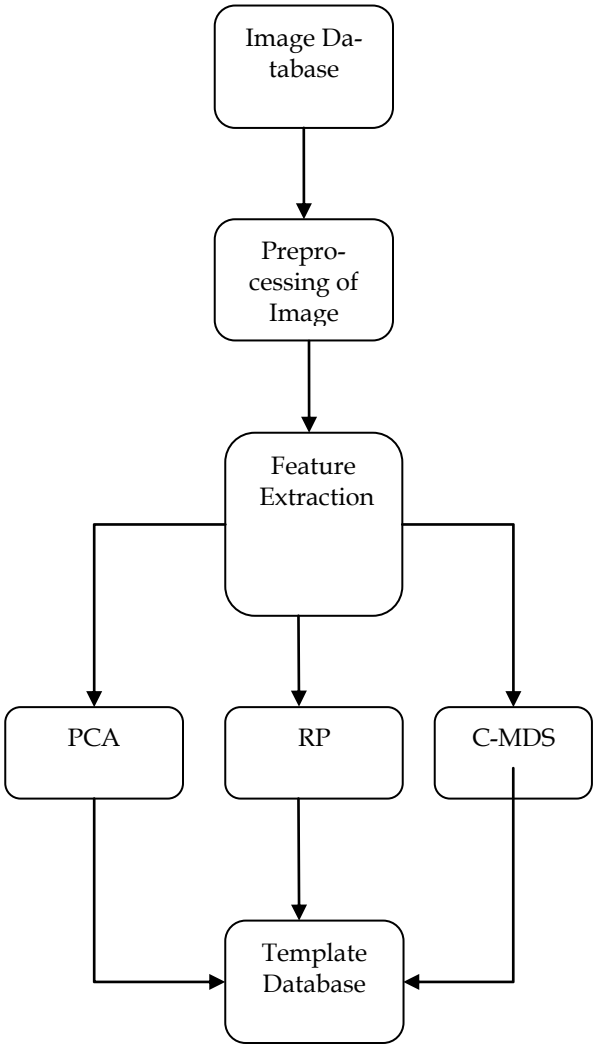

Fig 2: Training Phase of Biometric System

For Classical multidimensional Scaling algorithm (C-MDS) require dissimilarity matrix (DS) as an input. To get this DS matrix first we read image of size 92X112. After applying concatenation we get vector of 10,304 values. Then set block

Testing Phase:

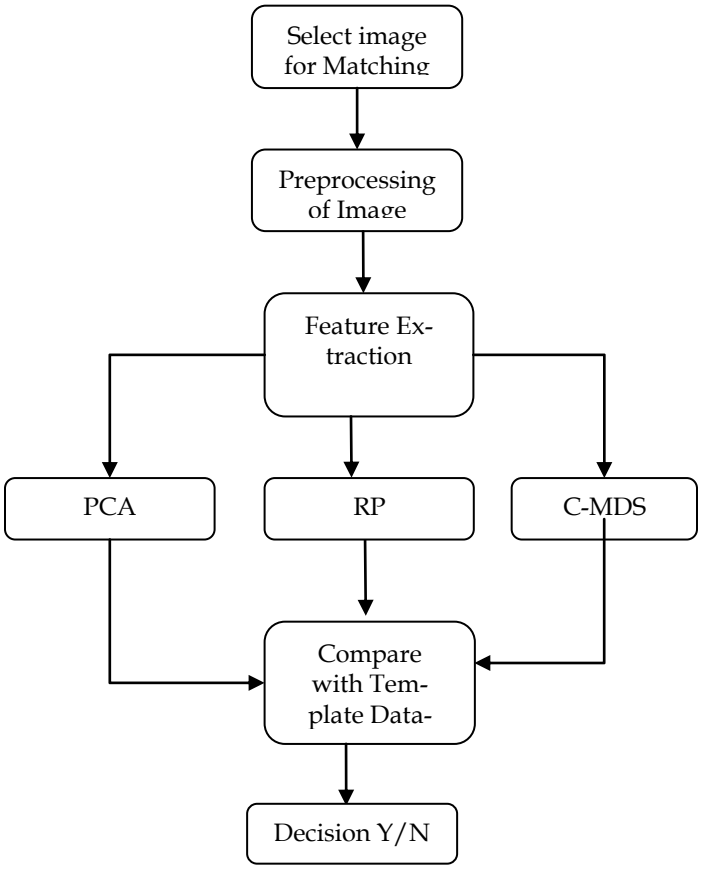

Fig 3: Testing Phase of Biometric System

size 50. So in equating total we get 206 blocks. Then we find distance of each block with all other blocks and get dissimilarity matrix of size 206X206. This Dissimilarity matrix is given to the Classical MDS Algorithm for further processing.

The following steps summarize the algorithm of classical MDS[5]:

1. Calculate squared proximities of matrix.
2. Apply the double centering.
3. Extract the largest positive eigenvalues.
4. An m-dimensional spatial configuration of the n objects is derived from the coordinate matrix X.

After applying C-MDS we get reduced dimemsion which is of size 2X206.

4 EXPERMENTS AND RESULTS

To evaluate the performance of proposed method we have implemented biometric system using PCA, PCARP, RP [2], and C-MDS methods.PCA [11] is a very common technique of dimensionnality reduction but it is computationaly expensive. Proposed method significantly reduces dimension as compared to other methods hence Recognitition accuracy also

Sr.No.	Algorithm Used	% of image Database	Recognition Accuracy in %	Training Time in Second
1	PCA	20%	51.25	15
2	RP	20%	52.5	88
3	PCARP	20%	53.75	13
4	C-MDS	20%	60	29
5	PCA	40%	70	13
6	RP	40%	73.33	85
7	PCARP	40%	70	11
8	C-MDS	40%	80	29
9	PCA	60%	85	11
10	RP	60%	90	84
11	PCARP	60%	92.5	10
12	C-MDS	60%	93	28

Table 1: Result of Biometric System

increases as compared to the other methods. Training time required to proposed method is also low as compared to other methods.We have used Faces Dataset consisting of 100 images.

4. CONCLUSION

This paper has presented the analysis of Classical Multidimensional Scaling algorithm for addressing the challenging problem of template protection and curse of dimensionality in biometric based authentication system.

The proposed method not only protects the template but also reduces dimensions of the image drastically.Ultimately size of template database get reduced.It also improves the recognition accuracy as compared to other methods.

5. REFERENCES

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